Appln. No. 09/687,759
Amendment dated July 1, 2005
Reply to Office Action mailed March 3, 2005

## AMENDMENTS TO THE SPECIFICATION

On page 8, please replace the first through sixth full paragraphs with the following amended paragraphs, respectively:

Figures 2A to 2C are [[is]] a plot of DCLR versus crown angle over three thresholds for a modeled round brilliant diamond along with the table of corresponding data.

Figures 3A to 3C are [[is]] a plot of DCLR versus pavilion angle over three thresholds for a modeled round brilliant diamond along with the table of corresponding data.

Figures 4A to 4C are [[is]] a plot and table of DCLR with reference to crown angle and table size for a low power density threshold cutoff modeling system.

Figures 5A to 5C are [[is]] a plot and table of DCLR with reference to crown angle and table size for a medium power density threshold cutoff modeling system.

Figures 6A to 6C are [[is]] a plot and table of DCLR with reference to crown angle and table size for a high power density threshold cutoff modeling system.

Figures 7A and 7b are [[is]] a table of DCLR rating for various diamond proportions, varying by star facet length, for 3 values of crown angle.

On page 8, please replace the ninth through eleventh full paragraphs with the following amended paragraphs, respectively:

Figures 10A to 10F are [[is]] a table of DCLR ratings for various diamond proportions, varied by pavilion angle and table size, for a high power density threshold cutoff modeling system.

Figures 11A to 11F are [[is]] a table of DCLR ratings for various diamond proportions, varied by pavilion angle and table size, for a medium power density threshold cutoff modeling system.

Figures 12A to 12F are [[is]] a table of DCLR ratings for various diamond proportions, varied by pavilion angle and table size, for a low power density threshold cutoff modeling system.

On page 10, please replace the sixth and seventh full paragraphs with the following amended paragraphs, respectively:

Figure 25 is a plot of DCLR versus culet size corresponding to Figures 26A and 26B.

Figures 26A and 26B are [[is]] a table of DCLR rating for certain diamond proportions, varying by culet size.

Please replace the paragraph bridging pages 12 to 13 with the following amended paragraph:

Although the human visual system can detect as few as 7 photons when it is fully adapted to the dark, far more light is required to stimulate a response in an ordinarily bright room. The specific range of the human visual system in ordinary light has not been definitively measured, but professional estimates suggest detection of up to 10,000 gray levels. (A computer monitor uses 256 levels, and high-quality photographic film has just under 1000). Thus it is uncertain how much of fire to take into consideration to match the capacity of human vision: Accordingly, one embodiment of the metric comprises a threshold power density cutoff to approximate human vision. Furthermore, the power density threshold may be weighted to account for differentiation in human eye sensitivity to different parts of visual spectrum (e.g., use a higher threshold cutoff for green light because humans have lower sensitivity for green as compared This to blue light). This principle also applies with force to the scintillation metric. As disclosed herein, DCLR values may be calculated using ranges of 2, 3, and 4 orders of magnitude (i.e. including rays down to 100 (fire 2), 1000 (fire 3), and 10,000 (fire 4) times weaker than the brightest ones). In the preferred embodiment, DCLR is a directly computed value, and traces all light from the source so there is no convergence and no error. The results are shown as DCLR values graphed against various proportion parameters. See Figs. [[2-6]] <u>2A to 2C through 6A to 6C</u>. Fire 2 means that a threshold eliminates refracted light elements at less than 1% of the brightest light elements. Fire 3 uses a cut off of .1% off and Fire 4 uses a .0l% cut off. The obvious result from this initial data is that DCLR (and thus fire) does not have a monotonic dependence on only the crown proportions, as Tolkowsky's 1919 work claimed, but shows a multi-valued dependence on several proportions, including the pavilion angle. In other words, DCLR like WLR, can be maximized in a number of ways.

On page 14, please replace the first full paragraph with the following amended paragraph:

Although the DCLR may be calculated for the idealized set of average proportions, they may also be calculated for that of a particular stone. Thus, in another embodiment, a low end grade may be used for the diamond industry and jewelers; the metrics disclosed herein readily identify sets of proportions with poor optical performance. See Figs. [[2-6]] <u>2A to 2C through 6A to 6C</u>.

Please replace the paragraph bridging pages 15 to 16 with the following amended paragraph:

Dodson (1979) evaluated his metrics for 3 crown heights (10, 15, and 20%), 4 table sizes (40, 50, 60, 70%), and 10 pavilion angles between 38 and 55%, a total of 120 proportion combinations, and showed that his three metrics yielded wide variations across these proportions. In contrast, the present description includes a calculated

DCLR for 2148 combinations of 6 proportions: crown angle, pavilion angle, table size, star facet length, lower girdle length, and culet size. (This range includes both common commercial proportions and values of crown angles and star facet lengths that are very rarely cut). See Figs. 7A and 7B through 12A to 12F[[Fig. 7-12]]. These metrics are computed functions of the 8 independent shape variables, and each data set forms a surface over the 6 shape variables we have varied to date. We have explored the topography of the DCLR surface with standard graphical and numerical techniques, to find all those combinations that yield high DCLR, and to reveal relationships between proportions and brightness.

On page 17, please replace the first, second and third full paragraphs with the following amended paragraphs, respectively (note: underscoring of initial phrase in each paragraph is original):

Results for Key Individual Parameters. Our investigation of the dependence of DCLR on crown angle, pavilion angle, star facet length, and table size, began with an examination of how DCLR varies with each of these three parameters while the remaining seven parameters are held constant. Except where otherwise noted, we fixed these parameters at the reference proportions (see fig. 1). See Figs. 7A and 7B through 12A to 12F[[Fig. 7-12]].

Crown Angle. In general, DCLR increases as crown angle increases; but, as Figures 2A to 2C show[[s]], there are two local maxima in DCLR across the range of angles, at about 25° and 34-35°, and a rise in values at crown angles greater than 41°. However, moderately high crown angles of 36-40° yield a lower DCLR value than either of the local maxima. The same topography is seen at each of the three thresholds, although the numerical range of each data set (the difference between the maximum and minimum values) decreases as the threshold is raised.

Pavilion Angle. This is often cited by diamond manufacturers as the parameter that matters most in terms of brilliance (e.g., G. Kaplan, pers. comm., 1998), but we surprisingly found the greatest variation in DCLR for changes in pavilion angle. Figures 3A to 3C show[[s]] an overall decrease in DCLR (calculated with the lowest threshold) with increasing pavilion angle, with a true maximum at 38.75°, and local maxima at 40-41° and 42.25°. Unlike crown angle, pavilion angles are typically manufactured in a fairly narrow range; the peak from 40-41° covers a broad range for this parameter. Similar topography is seen for the intermediate threshold, but the peak at low pavilion angle is absent from DCLR calculated at the highest threshold.

On page 18, please replace the first full paragraph with the following amended paragraph (note: underscoring of initial phrase in paragraph is original):

Star Facet Length. We calculated the variation of DCLR (with the lowest threshold) with changes in the length of the star facet for three values of the crown angle: 34°, 36°, and 25°. The range in DCLR values is relatively small, but as seen in

Figs. 7A and 7B, 8, and 9 there is a primary maximum in each array. At the reference crown angle of 34°, a star facet length of .56 yields the highest DCLR. This maximum shifts to about .58 for a crown angle of 36°, and increases substantially to a star facet length of .65-.65 for a crown angle of 25°. Longer star facet length means that the star facet is inclined at a steeper angle relative to the table (and girdle, in a symmetrical round brilliant), and thus these results imply that the star facets act similarly to the bezel facets with regard to the production of fire. Also, as with crown angle, similar topography is seen in the arrays calculated with higher thresholds but with significantly reduced range of DCLR values.

On page 18, please replace the third full paragraph with the following amended paragraph (note: underscoring of initial phrase in paragraph is original):

Table Size. DCLR shows a bi-modal response to variations in table size, as shown in Figs. 10A to 10F, 11A to 11F, and 12A to 12F. For the low and medium thresholds, DCLR is approximately constant for tables less than .55, rapidly decreases for tables of .56 and .57, and then remains approximately constant for tables of .58 and greater. For the highest threshold, DCLR is approximately constant across the entire range of table sizes. See, e. g., Fig. 23.

On page 19, please replace the first full paragraph with the following amended paragraph (note: underscoring of initial phrase in paragraph is original):

Culet Size. Unlike WLR, which showed little dependence on culet size, DCLR decreases significantly with increasing culet size. This decrease is smooth and monotonic, and for the lowest threshold the DCLR value decreases by 25%. See Figs. 25, [[-]]26A and 26B.

On page 19, please replace the fourth full paragraph with the following amended paragraph:

Figures 4A to 4C shows such a contour map for DCLR (calculated with the lowest threshold) with variation in both crown angle and table size. Two "ridges" of rapidly varying DCLR values are evident at crown angles of 25-26° and crown angles greater than or equal to 34°. This latter ridge is broad and shows convoluted topography. These ridges become gullies with decreasing table size; that is, at these crown angles, table sizes of .58 and less yield high DCLR values, but larger table sizes yield lower DCLR values than are found at other crown angles. In particular, there is a local maximum in DCLR for tables of .65-.63 and a crown angle of 29°.

On page 20, please replace the first and second full paragraphs with the following amended paragraphs, respectively:

Figures 10A to 10F, 11A to 10F and 12A to 10F give the data for variation in DCLR as pavilion angle and table size each vary, for the three thresholds. The topography becomes much more complex as the threshold is lowered, and the range of values increases considerably. For the lowest threshold, there is a small ridge at a pavilion angle of 38.25 and table sizes of .56 and lower, and for all three thresholds there is a long ridge at a pavilion angle of 39.25 across the whole range of table sizes. This ridge appears more broad at the highest threshold, covering pavilion angles from 39-41°.

Importantly, the Figures 4A to 4C through 6A to 6C [[-6]] and 10A to 10F through [[-]] 12A to 12F demonstrate that preferred "fire" proportions based on the disclosed proportion parameters can serve as guides or even ranges in a cut grade determination.